



089759

REPORT TO THE COMMITTEE
ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES



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Computer Simulations,
War Gaming,
And Contract Studies B-163074

Department of Defense

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BY THE COMPTROLLER GENERAL
OF THE UNITED STATES

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FEB. 23, 1971



COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-163074

Dear Mr. Chairman:

In accordance with your request dated July 27, 1970, this is our initial report on computer simulations, war gaming, and contract studies in the Department of Defense.

In chapter 5, we have listed a number of matters that may be of immediate interest to the Committee as well as those aspects of simulations, war gaming, and contract studies that we plan to review in the future. As we complete our subsequent reviews in these areas, we will forward reports to you.

Formal comments on our findings have not been requested from the Department of Defense. We plan to make no further distribution of this report unless copies are specifically requested, and then copies will be distributed only after your agreement has been obtained or public announcement has been made by you concerning its contents.

Sincerely yours,

A handwritten signature in cursive script, reading "James B. Stacks", is written over the typed name.

Comptroller General
of the United States

The Honorable George H. Mahon
Chairman, Committee on Appropriations
House of Representatives

COMPTROLLER GENERAL'S
REPORT TO THE COMMITTEE ON
APPROPRIATIONS
HOUSE OF REPRESENTATIVES

COMPUTER SIMULATIONS, WAR GAMING,
AND CONTRACT STUDIES IN
THE DEPARTMENT OF DEFENSE B-163074

D I G E S T

WHY THE REVIEW WAS MADE

At the request of the Chairman, Committee on Appropriations, House of Representatives, the General Accounting Office (GAO) has inquired into selected aspects of computer-oriented war gaming, computer simulations, and contract studies sponsored by the Department of Defense. The primary objectives of the inquiry were to identify the extent and related costs of

- computer simulation activity;
- computer or computer-assisted war gaming; and,
- contract studies for strategic, tactical, politico-military, and related areas.

GAO also looked into the conduct and utilization of a number of recently completed war games. Because of the magnitude of the subject area and the limited time available, much of the data obtained during GAO's inquiry was compiled at GAO's request by various Department of Defense activities and was not verified independently by GAO. Formal comments on GAO's findings have not been requested from the Department of Defense.

FINDINGS AND CONCLUSIONS

Computer simulation is a popular analytical technique throughout the Department of Defense because of its value in analyzing complex systems and in testing the effect of proposed policies and procedures. The estimated cost of the simulation effort during fiscal year 1970 represented a Defense-wide expenditure of about \$172 million. The most extensive uses of computer simulations have been by the Air Force and the Army. Within those services simulation is used primarily in research, development, and testing activities. (See p. 8.)

The extent of war gaming as an analytical tool in the Department of Defense is evidenced by the fact that GAO identified 61 military and contractor organizations that participated in computer or computer-assisted war games in one form or another during fiscal year 1970. This effort required an expenditure of about \$13.8 million, of which \$6.4 million was contract costs.

Tear Sheet

FEB. 23, 1971

There is no centralized responsibility within the Department of Defense for coordinating and controlling the various war gaming activities. Although GAO has found some indications of efforts to encourage and enhance the exchange of information and to promote coordination, the military departments are operating more or less independently. In GAO's opinion, this environment is conducive to redundancy and duplication of effort. (See p. 17.)

The Navy is planning a major improvement in war gaming equipment at the Naval War College. Equipment will be procured in four phases at a total estimated cost of about \$16.3 million. The improvement program is expected to be completed in fiscal year 1974. (See p. 19.)

The Department of Defense and the General Services Administration are planning to establish the Federal Automatic Data Processing Simulation Center. Its proposed charter states that the Center will provide technical support and services to all elements of the Federal Government in the area of simulation of data processing systems. It is tentatively scheduled to become operational on July 1, 1971. (See p. 15.)

Studies and analyses are also performed under contracts awarded by the Department of Defense. A total of 209 contract studies costing about \$100 million were identified that were awarded to a selected number of contractors (28) during fiscal year 1970. Approximately one half of the studies were directed to strategic, tactical, and politico-military problems; about one third were scientific and technological in nature; and the remainder were in the manpower, personnel, and management areas. Of the 28 contractors, 15 accounted for contracts totaling \$91 million. (See p. 23.)

Some of the titles, descriptions, and/or objectives of the simulations, war games, or contract studies included in GAO's inquiry appeared to have a degree of similarity sufficient to indicate that some duplication of effort in these areas may be occurring either within or among the military departments. (See pp. 10, 11, 16, 19, and 24.)

A number of studies were being performed under what are generally referred to as level-of-effort contracts. The scope of the work set out in these contracts is very general, and the specific tasks to be performed are not agreed to until after the award of the contracts. Various Defense and military activities rely to a great extent on this type of support to supplement and/or complement in-house expertise. (See p. 25.)

Overall observations and
suggestions for further study

GAO has not fully explored certain potentially troublesome management areas, but there appears to be a need for additional study of:

--The changes in data processing equipment, the extent of utilization of the facilities, and the overall benefits expected in the improvement program for war gaming at the Naval War College.
(See p. 26.)

--What controls will be instituted to ensure that Government agencies make use of the available services of the Federal Automatic Data Processing Simulation Center and once the Center becomes fully operational, whether there is any intention to expand its role to simulations other than those for automatic data processing equipment configuration and acquisition. (See p. 26.)

--The indications of possible similarity and duplication of effort in simulations, war games, and contract studies, as well as whether the input data are realistic and the results are utilized effectively. (See p. 26.)

--The appropriateness of using the level-of-effort type of contract, which initially prescribes no specific tasks, for the studies area.
(See p. 27.)

GAO believes that the Committee may wish to explore these matters with the agencies involved. However, GAO intends to look into the last two items listed above in greater detail.

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CHAPTER 1

INTRODUCTION

At the request of the Chairman, Committee on Appropriations, House of Representatives, the General Accounting Office has inquired into selected aspects of computer-oriented war gaming, computer simulations, and contract studies sponsored by the Department of Defense.

The primary objectives of our inquiry were to identify the extent and related costs of (1) computer simulation activity, (2) computer or computer-assisted war gaming, and (3) contract studies for strategic, tactical, politico-military, and related areas. We also looked into the conduct and utilization of a number of recently completed war games. We did not attempt, during the course of these preliminary inquiries, to evaluate management controls, the effectiveness of computer programs, or the utilization of the results obtained. Additional reviews to look into selected areas that appear to warrant attention are being planned. (See p. 27.)

Because of the magnitude of the subject area and the limited time available, much of the data obtained during our inquiry was compiled at our request by various Department of Defense activities and was not verified independently by us. We were advised by the Office of the Secretary of Defense and by the military agencies that the data might be subject to omissions, inaccuracies, and incompleteness because of (1) individual judgments concerning the meaning of the word "simulation," (2) differing interpretations of costs associated with analysis, programming, and machine utilization, and (3) difficulties of gathering data within the time constraints and in the form requested.

Simulation

Computer simulation is an analytical technique which involves the use of mathematical and logical models to represent and study the behavior of real-world or hypothetical events, processes, or systems over extended periods of time.

Simulation provides the means for gaining experience and for making and correcting errors without incurring the costs or risks of actual application. It offers opportunities to test theories and proposed modifications in systems or processes; to study organizations and structures; to probe past, present, and future events; and to utilize forces that are difficult or impracticable to mobilize. Simulation therefore is of value both as an educational device and as a means of discovering improved methods.

Simulation should be used when (1) it is either impossible or extremely costly to observe certain processes in the real world, (2) the observed system is too complex to be described by a set of mathematical equations, (3) no straightforward analytical technique exists for solution of appropriate mathematical equations, and (4) it is either impossible or very costly to obtain data for the more complicated mathematical models describing a system.

On the other hand simulation should not be used when (1) simpler techniques exist, (2) data are inadequate, (3) objectives are not clear, (4) there are short-term deadlines, or (5) the problems are minor.

WAR GAMING

One of the major applications of simulation is war gaming. A war game is defined by the Department of Defense as a simulation of a military operation involving two or more opposing forces and using rules, data, and procedures designed to depict an actual or assumed real-life situation. It is primarily a technique used to study problems of military planning, organization, tactics, and strategy.

A war game can be conducted to cover the entire spectrum of war, i.e., politico-military crises, general war, or limited war. The game may be based on hypothetical situations, real-world crises, or current operational plans. Some games are designed for joint operations by two or more military services, some are for use by a single service, and others may be used by individual Army field commanders or even by division or battalion commanders. The level of command at which the game is to be played, of course,

influences the type of units to be represented and the scope of operations to be conducted.

There are three types of war games in common use today: the training game, the operational game, and the research game. The training game is the least complex and is designed to provide the participants with decisionmaking opportunities similar to those that may be experienced in combat. The operational game deals with current organizations, equipment, and tactics. It is more complex than the training game, uses inputs that are based on known quantities, and is used to test operational plans. The research game, which is the most complex of the three types of games, requires careful preparation to achieve maximum objectivity and usually is designed to study tactical or strategic problems in a future time frame.

A war game can be accomplished manually, can be computer-assisted, or can be wholly computerized. Manual games are played using symbols, pins, or pieces to represent forces, weapons, and targets on maps, mapboards, and terrain models. A computer-assisted game is a manual game using computerized models which free the control group from many repetitive and time-consuming computations.

Computer games are based on predetermined procedures. All simulation of conflict is done by the computer in accordance with the detailed instructions contained in the computer program. The primary advantage of computer gaming is that the same situation can be simulated many times under differing conditions, to observe variability of results. A computer war game requires the use of a war game model (i.e., computer program) which contains all the rules, procedures, and logic required to conduct the game. Development of such a model normally requires about 12 to 24 months depending on the complexity of the interactions and the experience level of the model developers.

CONTRACT STUDIES AND ANALYSES

The words "studies and analyses," as used in this report, refer to those studies and analyses which are done by

contract or by grant and which deal with the systematic and critical examinations of various subjects. Studies and analyses often require advanced analytical techniques to integrate a variety of factors and to evaluate data. Their purpose is to provide greater understanding of alternative organizations, tactics, doctrines, policies, strategies, procedures, systems, and programs.

Department of Defense Directive 5010.22 states that studies and analyses should be used as essential tools of management and that they should be considered integral parts of executive or command responsibility. This directive states also that control of studies and analyses is necessary to ensure visibility and usefulness of all such efforts. Department of Defense policy requires that control be exercised to ensure that initiation of studies is approved by appropriate senior officials and that the results of the studies receive appropriate management attention.

CHAPTER 2

COMPUTER SIMULATION ACTIVITY

IN THE DEPARTMENT OF DEFENSE

Computer simulation is a popular analytical technique throughout the Department of Defense because of its value in analyzing complex systems and in testing the effect of proposed policies and procedures. The variety of applications ranges from the simulation of automatic data processing equipment configurations to personnel management and planning, war gaming, and the development and testing of complex weapons systems.

The user community consists of a multiplicity of agencies, departments, commands, and individual elements therein, all of which utilize numerous computer facilities. The Department of Defense identified for us 214 activities that conduct computer simulations. These simulations were conducted at 181 Government and 184 contractor data processing facilities at a total estimated cost of about \$172.4 million for both computer and manpower costs during fiscal year 1970.

Computer costs are those costs associated with the actual operation and use of the computer and manpower costs are those costs for model and software development, preparation of inputs, and analysis and evaluation. We found that manpower costs usually were substantially higher than the costs of computer usage. We also noted that few, if any, computer systems were dedicated to special simulation activities but rather were utilized for a number of different applications. Shown below is a summary of the reported costs, by agency, for fiscal years 1970-72.

Estimated Cost of Computer Simulation Activity in the Department of Defense

<u>Fiscal</u> <u>year</u>	<u>Total</u>	<u>Army</u>	<u>Navy</u>	<u>Marine</u> <u>Corps</u>	<u>Air</u> <u>Force</u>	<u>DOD</u> <u>agencies</u>
	<hr/> (millions) <hr/>					
1970	\$172.4	\$34.7	\$23.7	\$.7	\$104.8	\$8.5
1971	170.5	35.1	25.8	1.3	100.3	8.0
1972	134.3	11.9	24.3	.2	91.5	6.4

As indicated above, the most extensive uses of computer simulations have been by the Air Force and the Army. Within these services simulation is used primarily in the areas of research, development, and testing activities.

The following narratives describe the more significant aspects of computer simulation activity in each of the military departments and the Defense agencies. A brief description of the functions of the various organizations discussed is included in appendix III.

DEPARTMENT OF DEFENSE AGENCIES

We identified eight organizations and agencies that conducted computer simulations, at a total cost of about \$8.5 million during fiscal year 1970. Of this total, about \$2.4 million represented computer costs and \$5.6 million was for model development, preparation of data inputs, and analysis of results.

The largest users among the Defense organizations and agencies were the Defense Communications Agency (about \$4.8 million) and the Joint Chiefs of Staff (about \$2.3 million). The Defense Communications Agency conducts four types of simulations: (1) survivability-vulnerability studies of communications systems, (2) evaluations of communications systems, (3) logistics, and (4) war gaming in support of the Office of the Secretary of Defense and the Joint Chiefs of Staff.

The Joint Chiefs of Staff conducted a variety of simulation projects in support of their roles as principal military advisors to the President and the Secretary of Defense and in the exercise of strategic direction over the unified and specified commands.

ARMY

Computer simulation expenditures for fiscal year 1970 in the Army totaled about \$34.7 million and were incurred by at least 17 Army commands and staff offices. A substantial portion of the Army costs, about \$28.1 million, was expended by five organizations: (1) Army Materiel Command,

(2) Office of the Chief of Research and Development, (3) Combat Developments Command, (4) Deputy Chief of Staff for Military Operations, and (5) Deputy Chief of Staff for Logistics.

Expenditures by the Army Materiel Command totaled about \$16.3 million for 240 projects and were incurred mainly by the research, development, and testing organizations. Two of the more extensive projects were: (1) a cost analysis trade-off of different logistic alternatives and inventory policies and (2) a simulation of the operation of the M60 tank.

Simulation efforts under the direction of the Office of the Chief of Research and Development cost about \$3.4 million and were conducted entirely under contract by the Research Analysis Corporation. The most costly project was the Automated Force Planning System study which cost about \$536,000. This system is being designed to analyze midrange requirements for nonnuclear general-purpose forces and their capabilities to cope with any one of several worldwide situations.

Of the total fiscal year 1970 expenditure by the Combat Developments Command, about \$1.7 million represented two large projects: (1) the Field Army Modernization War Game (costing \$1.1 million), designed to make a combat effectiveness comparison of forces and to identify strengths and weaknesses of various organizations and doctrines and (2) a study of the development and design of future tactical communications systems (costing \$660,000).

The simulation activity (costing \$2.1 million) by the Deputy Chief of Staff for Military Operations was conducted under the supervision of the Strategy and Tactics Analysis Group. About \$500,000 of the total simulation expenditure for this activity was spent on the Automated Force Planning System study. (This is the same project for which the Office of the Chief of Research and Development had assigned work to be performed, under contract, by Research Analysis Corporation.)

We also noted that the Strategy and Tactics Analysis Group was conducting a project called Quick Reaction Costing

for Major Forces. This is a rapid method of estimating total Army budget and personnel distribution, given total Army strength or monetary limitations. As discussed below, the Office of the Army's Deputy Chief of Staff for Logistics will spend about \$10.6 million over a 3-year period to install the Automated Procurement of Equipment and Missiles, Army Budget System. Although we have not yet made detailed analyses of these two projects, it appears that both involve methods of determining estimated overall Army costs and may possibly involve duplications of effort.

Some significant cost trends and observations were noted in other commands of the Army.

1. Funds expended by the Office of the Deputy Chief of Staff for Logistics will increase from about \$3.6 million in fiscal year 1970 to \$4.3 million in fiscal year 1971 and to \$5.3 million in fiscal year 1972. A substantial portion of the cost (\$10.6 million) is for the Automated Procurement of Equipment and Missiles, Army Budget System.

2. Expenditures by the Office of the Deputy Chief of Staff for Personnel will more than double, increasing from \$217,000 in fiscal year 1970 to about \$518,000 in fiscal year 1971. A significant portion of the increase is represented by a contract for modifications to the Enlisted Personnel Inventory Analysis System. There are indications that additional funds will be required in fiscal year 1972 to program the concepts developed under this contract.

3. Army Air Defense Command costs will increase from about \$387,000 in fiscal year 1970 to \$533,000 in fiscal year 1971. About \$103,000 of the increase is for the SAFEGUARD System Simulator.

4. SAFEGUARD System Command costs will increase from about \$2.9 million in fiscal year 1970 to \$3.5 million in fiscal year 1971 and to \$3.9 million in fiscal year 1972. A significant portion of the increase is for simulations to evaluate the performance of the SAFEGUARD System.

AIR FORCE

The Air Force expended about \$105 million to conduct computer simulation studies during fiscal year 1970. Although this total represented simulation activities by 21 major commands and organizations, the Air Force Systems Command accounted for \$101 million, or 96 percent of the total Air Force expenditure. The Systems Command had 13 different organizational elements reporting simulation activities in connection with its mission of advancing aerospace technology, adapting it into operational aerospace systems, and acquiring aerospace systems and materiel.

The total reported costs of \$101 million were understated, however, inasmuch as costs relating to 54 universities or contractors performing computer simulations under 57 contracts for the Air Force Office of Scientific Research were not included. We were advised that this information was not identifiable in contractual documents and that the Systems Command, within the time available, could not ascertain from all the organizations involved the extent of simulations being undertaken.

A further breakdown of the Systems Command's fiscal year 1970 costs indicated that:

1. In-house studies conducted totaled 567; contract studies totaled 686.
2. There was an indicated trend through fiscal year 1972 to increase in-house efforts and decrease the number of contract studies.
3. The Space and Missile Systems Organization, located at Los Angeles, California, accounted for \$61.3 million of the Systems Command's costs. This organization had 310 of its 312 studies under contract.
4. The Aeronautical Systems Division, located at Wright-Patterson Air Force Base, Ohio, that includes five major laboratories, accounted for \$28.6 million of the Systems Command's costs. This organization had 245 studies under contract.

In addition, trends in Air Force simulation activities were noted at other commands, as follows:

1. The costs of the Aerospace Defense Command, Ent Air Force Base, Colorado, will quadruple, increasing from about \$247,000 in fiscal year 1970 to about \$1 million in fiscal year 1972. The primary reason for this increase is the combined contractor- and in-house-supported projects to be conducted during fiscal years 1971-72. One project will be the Aerospace Defense Capabilities Analysis Model which will be designed to develop and test aerospace defense capabilities. Estimated annual costs relative to this project are \$60,000 in fiscal years 1971-72. A second project accounting for a significant part of the increase is the Integrated Space Surveillance System. The estimated costs of this project are expected to be \$140,000 in fiscal year 1971 and \$640,000 in fiscal year 1972.

2. Headquarters, Data Systems Design Center, expenditures will more than double, increasing from about \$164,500 in fiscal year 1970 to about \$402,700 in fiscal year 1972. This effort involves simulations that evaluate automatic data processing systems design.

3. Expenditures by the Office of the Assistant Chief of Staff, Studies and Analysis, will increase by about 53 percent from \$476,000 in fiscal year 1970 to about \$725,000 in fiscal year 1971. Most of the effort by this organization supports tactical and strategic air studies.

NAVY

Computer simulation expenditures by 24 major naval commands and organizations for fiscal year 1970 totaled \$23.7 million. The largest Navy users of simulations were the Naval Air Development Center, Johnsville, Pennsylvania; Naval Weapons Center, China Lake, California; and Naval Air Systems Command, Washington, D.C. These three activities accounted for \$10.3 million, or 44 percent, of the total Navy expenditures, and indications are that fiscal year 1971 costs will increase.

Significant trends in costs were noted among other Navy organizations.

1. Costs at the Naval Underwater Systems Center, New London Laboratory, New London, Connecticut, will increase from about \$316,000 in fiscal year 1970 to \$1.3 million during fiscal year 1971. Most of the increase will be due to a simulation project called Display Parameter Evaluation which is intended to determine the minimum essential features that a ship's display console needs for an observer to perform his job.

2. Costs at the Naval Ordnance Laboratory, White Oak, Maryland, will increase from about \$450,000 in fiscal year 1970 to about \$845,000 in 1971. A project called Ships Electronics Susceptibility and Computer Analysis Technology Development represents a significant part of the increase. This project has a twofold purpose: (a) to evaluate the vulnerability of electrical circuits and/or systems aboard ships and (b) to improve the simulations utilized for these evaluations.

MARINE CORPS

Computer simulation activity, costwise, in the Marine Corps was minor compared with that of Defense agencies and other military services. The Marine Corps spent about \$673,000 for simulations during fiscal year 1970 and will spend about \$1.3 million in fiscal year 1971. A substantial portion of the increase will result from a contract project called Landing Force Integrated Communications Systems

which is to define the communications requirements for the Marine Corps in the 1975-85 time frame.

FEDERAL AUTOMATIC DATA PROCESSING SIMULATION CENTER

We have learned that the Department of Defense and the General Services Administration are planning to establish the Federal Automatic Data Processing Simulation Center, within the Air Force, which will be located at Hanscom Field, Massachusetts. It is tentatively scheduled to become operational on July 1, 1971.

The proposed charter states that the Center will provide technical support and services to all elements of the Federal Government in the area of simulation of data processing systems. Such support and services will serve two prime roles: (1) simulation in support of the procurement of data processing systems, which involves assisting in the tasks of cost estimation, competitive analysis, feasibility studies, requirements analysis, and evaluation of proposals and (2) simulation in support of the management of data systems, which involves assisting in the tasks of preparation of systems specifications, software design, system design, resources allocation, traffic analysis, scheduling, and systems augmentation.

The currently proposed operating procedures for the Center specify that any Government agency requiring simulation assistance be required to utilize the services of the Center unless specific conditions dictate otherwise. They do not, however, indicate what controls, if any, will be established to ensure that this requirement will be met.

The General Services Administration will provide the initial financing for creation and operation of the Center under the authority granted in Public Law 89-306 dated October 30, 1965. The Administration has set aside \$330,000 of fiscal year 1971 funds and \$650,000 of fiscal year 1972 funds for these purposes. Subsequent normal operational expenses will be reimbursed by the users under an industrial fund arrangement.

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Simulation activities in the Department of Defense cover a wide range of technical and management problems and represent significant expenditures. Our preliminary inquiries have indicated that there may be some duplication of effort by organizations developing simulations having similar objectives. In view of this, we plan to examine into the reasons for, results obtained from, and the extent of similarity in, these simulations.

CHAPTER 3

WAR GAMING IN THE DEPARTMENT OF DEFENSE

The extent of war gaming as an analytical tool in the Department of Defense is evidenced by the fact that 61 military and contractor organizations which participated in computer or computer-assisted war games in one form or another during fiscal year 1970 were identified. This effort required an expenditure of about \$13.8 million (see tabulation below), of which \$6.4 million were contract costs.

Estimated Cost of Computer and Computer-Assisted War Gaming in the Department of Defense

<u>Fiscal year</u>	<u>Total cost</u>	<u>Army</u>	<u>Navy</u>	<u>Air Force</u>	<u>Joint Chiefs of Staff</u>	<u>Joint unified and specified commands</u>
<hr/> (millions) <hr/>						
1970	\$13.8	\$4.4	\$4.4	\$2.7	\$1.3	\$1.0
1971	11.4	4.5	3.7	1.2	1.3	.7
1972	11.0	2.8	6.7	.3	(a)	1.2

^aNot available

The scope of war gaming efforts ranged from antisubmarine-warfare evaluations to games designed to assist high-level decisionmaking. In support of the latter effort, each of the military services has a war gaming activity assigned to its headquarters staff and the Joint Chiefs of Staff are provided with war gaming support by the Studies, Analysis and Gaming Agency. The Office of Secretary of Defense has access to a number of groups that utilize war games in their studies.

There is no centralized responsibility within the Department of Defense for coordinating and controlling the various war gaming programs. In some of the military

services, there are activities responsible for coordinating the war gaming program. For example, the Navy's Assistant for War Gaming Matters and the Army's Deputy Chief of Staff for Military Operations have this responsibility. Although we have found some indications of efforts to encourage and enhance the exchange of information and to promote coordination, the military departments are operating more or less independently. In our opinion, this environment is conducive to redundancy and duplication of effort.

COSTS

As in the case of other types of simulations, the cost for computer time represents only a relatively small portion of the total expenditures for war gaming, because there are few, if any, computers dedicated solely to war game activities. The data furnished to us by the various Department of Defense activities indicated that between 65 and 90 percent of the total costs were incurred for development of models (computer programs), preparation of data inputs, and analysis of game results.

The conduct of a computer war game requires the use of specifically designed models, the development of which is complex, time-consuming, and expensive. Within the Department of Defense, hundreds of different models have been developed for this purpose by the military departments. Technological changes in military weaponry and equipment have a tendency to outdate war gaming models. To remain abreast of these changes, existing models must be updated, modified, or revised or new models must be developed. If an existing model can satisfy the objectives of the games, it is far less costly to use or modify the existing model than to initiate development of a new model. The Navy plans to spend about \$4 million for the refinement of current models and the development of new and/or replacement models during fiscal years 1970-72.

The cost for analysis represents another major portion of the total war gaming cost. War games generate large quantities of data that must be analyzed in order that the results may be utilized for decisionmaking and/or training.

SIMILARITY OF WAR GAME STUDIES

In reviewing a listing of various war gaming studies in the Army that were conducted by the Strategy and Tactics Analysis Group, a support activity of the Deputy Chief of Staff for Military Operations, we noted that a number of studies had some aspects of similarity.

For example:

1. Capabilities War Game, Europe, Nuclear-1969 (CAPNUC-69)--A war game that investigated the capability of NATO theater nuclear and conventional forces to counter aggression initiated by the Warsaw Pact in Europe during the 1969 time frame. Three situations were gamed.
2. Tactical Nuclear Sufficiency for NATO (TANSUN)--A war game that investigated the requirements of NATO theater and conventional forces to counter Warsaw Pact aggression in Europe in the midrange time frame. Three distinctive NATO postures were gamed. The final report was prepared in 1969.
3. War Game Europe, Nuclear, 1973--A war game being conducted that will investigate NATO theater nuclear and conventional forces' abilities to counter Warsaw Pact aggression in Europe. Two alternatives differing in intelligence input data are being war gamed. The final report is scheduled for publication in February 1971.

We have not yet made any detailed analyses of these games, but the apparent similarities in these war gaming studies raise the possibility that there may be duplication of effort.

WAR GAMING AT THE NAVAL WAR COLLEGE

The Naval War College, Newport, Rhode Island, provides facilities in the Navy, for the conduct of war games by operational commanders. The actual gaming of fleet plans is

done by using the Navy Electronic Warfare Simulator, a system designed specifically for the simulation of naval warfare.

War games, in which the Navy Electronic Warfare Simulator is used, may be divided into two broad categories. In locally played games the players are physically present at the college, whereas in remote-play games the players participate through special communications networks from various ships or land-based commands throughout the world. The remote-play-game communications network was developed to permit commanders and their staffs to conduct games without the necessity for their being transported to the college.

During our inquiry, we learned that the Navy had determined that a major improvement in war gaming facilities would be required if the Naval War College were to maintain a satisfactory war gaming capability. The Navy believes that its needs are growing beyond the capability and capacity of the Navy Electronic Warfare Simulator and that advances in science and engineering have accelerated the obsolescence of the system.

A program has been established to improve the capability of the Navy Electronic Warfare Simulator. The program will result in a new war gaming system called the Warfare Analysis and Research System. Each planned increment of the improvement program will provide an increased gaming capability through a technical improvement in the equipment. It is planned that, upon completion of the program in fiscal year 1974, the Naval War College will possess facilities employing the most advanced and reliable state-of-the-art technology and having the capability of meeting all present and foreseeable war gaming needs. According to the acquisition schedule, the equipment will be procured in four phases, and its total cost is estimated at \$16,357,000.

The Naval Electronic Systems Command is exercising overall technical supervision of the program. It is responsible for purchasing the equipment and for developing program specifications. The program development will be accomplished by the Fleet Computer Programming Center, Pacific.

Since the system incorporates new equipment and techniques into the Naval War College facilities, additional personnel (number undetermined at this time) will be required to program, operate, and maintain the system. The Navy believes that the system will have a minimum impact on maintenance since the equipment is primarily the same type of equipment being used in other Navy applications. Therefore only minor special training will be required to support some special equipment.

UTILIZATION OF SELECTED WAR GAMES

During our inquiry we looked into the conduct and utilization of selected war games conducted by the Army, Navy, and Air Force. The games selected were recently completed and were representative of the type of games conducted by the military services. Most of the data that were used and the results of the games are classified information. Our observations of the results are therefore general in nature.

In one instance, where the application of two similar proposed types of equipment were simulated, the results indicated which equipment would be of greater value in accomplishing the mission that was gamed. These results, along with other data, were furnished to the Office of the Chief of Staff and to the Office of the Secretary of Defense for their consideration in future planning and courses of action.

We noted that the results of this particular game supported the acquisition of a major weapons system that the military service had been advocating for some time. In this type of game (which in many respects is similar to a cost-effectiveness study), it is essential that the input data and the assumptions be examined closely to ensure that the results are objective. We did not attempt, at that time, to make such an analysis, nor did we determine whether management personnel within the military service and the Office of the Secretary of Defense had done so.

In another military service the results of a war game were used to determine the effectiveness of tactics and force levels. These results were then tested in live

exercises and eventually were used as a basis for the preparation of new manuals on tactics.

In these two instances, the results of the war games formed the bases for certain affirmative actions (i.e., recommendation for acquisition of a weapons system and development of new tactics). In another instance, we were unable to determine what use, if any, had been made of the data generated by a war game.

CHAPTER 4

CONTRACT STUDIES AND ANALYSES

Closely related to many of the simulation efforts conducted within the Department of Defense are the studies and analyses conducted by contractors for the Department. To determine the nature of the studies that were placed under contract, we selected 25 nonprofit firms and six for-profit firms from a Department of Defense listing of 500 contractors that received the largest dollar volume of contract awards. We obtained from the Department of Defense and the military departments an identification of contracts for studies and analyses awarded to those firms during fiscal year 1970.

A total of 209 contract studies costing \$99.7 million were identified. Approximately one half of the studies involved strategic, tactical, and politico-military problems and about one third were scientific and technological in nature. The Advanced Research Projects Agency, a research activity attached to the Office of the Director of Defense Research and Engineering, sponsored practically all the scientific and technical effort. The remaining studies were in the manpower, personnel, and management areas.

The Advanced Research Projects Agency sponsored 97 studies, the Army 43, and the Navy 29. The Air Force initiated only four contract studies, but one of the contracts was for Project RAND at a cost of \$12.6 million. The Air Force usually uses contractors to analyze problems associated with specific weapon system programs.

An identification of the major contractors and the dollar amount of their contract studies are set out in the following schedule.

Listing of Major Contractors
Awarded Contracts for Studies and Analyses
Fiscal Year 1970

<u>Contractor</u>	<u>Number of contract studies</u>	<u>Dollar amount</u>
RAND Corporation	5	\$16,250,000
Institute of Defense Analyses	5	9,420,643
University of Rochester	6	9,329,737
Cornell Aeronautical Laboratory	3	7,627,778
Computer Sciences Corporation	7	7,175,000
Massachusetts Institute of Technol- ogy	13	7,150,000
Stanford Research Institute	32	6,239,430
Research Analysis Corporation	35	5,910,219
University of California	16	5,217,000
University of Illinois	5	4,435,000
MITRE Corporation	1	2,950,000
Battelle Memorial Institute	6	2,616,900
Stanford University	7	2,464,000
Systems Development Corporation	6	2,410,505
Technical Operations, Inc.	<u>14</u>	<u>2,018,284</u>
Total	<u>161</u>	<u>\$91,214,496</u>

On the basis of a limited analysis of the contract studies and analyses area, our most significant observations were as follows:

1. We identified a number of contracts and in-house studies that appear to be similar in scope. For example, the following Air Force and Office of the Secretary of Defense contracts and studies relate to bomber penetration capabilities.

- a. Air Force contract with Cornell Aeronautical Laboratory for Analysis of Penetration Aids. Cost--\$7,350,000.
- b. Air Force contract with The Boeing Company at \$924,736 (FY 1970) and \$150,000 (FY 1971) for an advanced penetration model. Cost--\$1,074,736.

- c. Air Force contract with North American Rockwell Autonetics for Strategic Bomber Penetration. This contract involves studies to evaluate penetration aids and concepts. Cost--\$245,000.
- d. Defense Communications Agency awarded a contract for the Office of the Secretary of Defense to Stanford Research Institute to Develop Techniques to Evaluate the Effectiveness of Bomber Penetration. A follow-on contract for Air Defense/Bomber Penetration was awarded to Stanford Research Institute for fiscal year 1971. Costs for the two contracts--\$215,000.
- e. An in-house simulation study called Saber Penetrator was conducted by the Air Force. This is a continuing study that analyzes bomber vulnerability-survivability.
- f. An Air Force simulation study called Low Altitude Penetration will be conducted during fiscal year 1971.

2. We observed that a number of studies were being performed under what are generally referred to as level-of-effort contracts. This type of contract provides a type of service--for example, operations research and systems analysis--for a specified number of man-months at an estimated price. It usually spans a multiyear period and is renegotiated annually. The scope of work set out in the contract is very general, and the specific tasks to be performed by the contractor are not agreed to until after the award of the contract.

Various Defense and military activities rely to a great extent on this type of support to supplement and/or complement in-house expertise. Some examples of level-of-effort contracts are those with the Center for Naval Analyses, Institute for Defense Analyses, RAND Corporation, and Stanford Research Institute. We found that awards on this type of contract ranged from \$325,000 to about \$12 million.

CHAPTER 5

OVERALL OBSERVATIONS AND SUGGESTIONS

FOR FURTHER STUDY

The expenditures for simulations, war games, and related contract studies represent a significant annual investment of funds by the Department of Defense. Our limited inquiries indicated certain potentially troublesome management areas in which there appeared to be a need for further study.

1. The Major Improvement Program for war gaming at the Naval War College, Newport, Rhode Island (see p. 19), represents a significant updating in automatic data processing equipment at that activity. The total cost of this program is estimated at \$16,357,000. The Committee may wish to discuss with Navy officials the need for the changes in data processing equipment, the extent of utilization of the facilities, and the overall benefits expected to be realized.

2. The Federal Automatic Data Processing Simulation Center (see p. 15), if established as planned, will have a significant effect on automatic data processing system simulation throughout the Federal Government. If the Center functions in accordance with the expectations of its planners, it can probably reduce the costs of simulation activity throughout the Federal Government. The Committee may wish to discuss with Air Force and General Services Administration officials what controls will be instituted to ensure that Government agencies make use of the available services and whether, once the Center becomes fully operational, there is any intention to expand its role to simulations other than those for studying the acquisition of data processing equipment.

3. We estimate that during fiscal year 1970 the Department of Defense expended about \$286 million for the types of simulations, war games, and contract studies discussed in this report. In each of these areas, it is essential that effective management controls exist to ensure that:

- a. There are no duplications of effort.
- b. Appropriate consideration is given to the results of the studies, games, etc.
- c. Input data are realistic.

Our preliminary inquiries indicated that these matters warrant detailed reviews, and we are planning to initiate such reviews in the near future.

4. A substantial expenditure is made annually for studies and/or services under level-of-effort-type contracts which initially prescribe no specific tasks. In effect, these are contracts for personal services, and we intend to look into the appropriateness of using this type of contract for the studies area.

APPENDIXES

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Congress of the United States
House of Representatives
Committee on Appropriations
Washington, D.C. 20515

September 24, 1969

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 EXT. 1771
 OR
 225-2771

Honorable Elmer B. Staats
 Comptroller General of the United States
 U. S. General Accounting Office
 Washington, D. C. 20458

Dear Mr. Staats:

The Committee hearings on the Department of Defense Operation and Maintenance budget requests for 1970 contain discussions of several new Automatic Data Processing (ADP) systems planned for installation in fiscal year 1970 and future years. Such systems as the Army "Conarc Class One Automatic System (COCOAS)," the Navy "Integrated Command/Management Information System (NICOMIS)," and the Air Force "Advanced Logistics System (ALS-X)" are actively under development.

It would be most helpful if the General Accounting Office maintained a direct effort in the area of development, installation, and operation of automatic data processing systems with periodic reporting of the results of its reviews. The guidelines established in earlier, related, Committee letters of November 28, 1967 and August 6, 1968 adequately state the scope of the work to be undertaken. Reports such as yours of March 13, 1968 and January 16, 1969 are of the type in which the Committee is interested.

The Committee would also be interested in an opinion as to the effectiveness of the directive of the Deputy Secretary of Defense, dated June 7, 1968, which places the responsibility for the management of automatic data processing functions under the control of the Office of the Assistant Secretary of Defense, Comptroller.

The Committee will appreciate the continued effort of the General Accounting Office in this area and your reporting of significant findings.

Sincerely,

George Mahon
Chairman

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Congress of the United States
House of Representatives
Committee on Appropriations
 Washington, D.C. 20515

July 27, 1970

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TELEPHONE:
 CAPITOL 4-3121
 EXT. 3771
 OR
 354-2771

Honorable Elmer B. Staats
 Comptroller General of the United States
 Washington, D. C. 20548

Dear Mr. Staats:

On September 24, 1969, this Committee requested the General Accounting Office to maintain a direct effort in the area of development, installation, and operation of automatic data processing systems in the Department of Defense with periodic reporting of the results of its reviews.

Within the scope of this broad request, the Committee would appreciate your inquiring into the management of automatic data processing equipment and related facilities used in War Gaming activities conducted by the Department of Defense. To ensure that your inquiry will be directed to the matters of most concern to the Committee, we suggest that your staff make a preliminary examination of this area for about 30 days and then meet with the Committee's staff to reach agreement on the specific subjects to be included in your review.

The Committee would appreciate receiving by January 31, 1971, the results of your inquiries into the matters selected for review.

Enclosed is a copy of a letter to the Secretary of Defense requesting his assistance in facilitating your work.

Sincerely,

George Mahon
 Chairman

DEPARTMENT OF DEFENSE

ORGANIZATIONS MENTIONED IN THIS REPORT

DEFENSE

Joint Chiefs of Staff. The principal military advisers to the President, the National Security Council, and the Secretary of Defense.

Studies, Analysis and Gaming Agency. Its overall mission is to plan, organize, and perform joint war games for the Joint Chiefs of Staff.

Defense Communications Agency. Is responsible for the management control and operational direction of the Defense Communications System, technical supervision of technical support for the National Military Command System, and support of the National Communications System function.

Advanced Research Projects Agency. A separately organized research and development agency under the direction and supervision of the Director of Defense Research and Engineering that is responsible for basic and applied research and development for such advance projects as the Director may assign.

ARMY

Office of the Chief of Research and Development. This Office, which is under the functional supervision of the Assistant Secretary of the Army (Research and Development), is responsible to the Chief of Staff. It has responsibility for all Army research, development, test, and evaluation, including review and analysis, research and development objectives, policies, and funds essential to the discharge of this responsibility; plans, projects, tasks, and priorities relating thereto; qualitative materiel requirements and small development requirements for all Army materiel; and the research and development aspects of international military cooperation programs. It also directs the Army Research Office.

Deputy Chief of Staff for Military Operations. Has General Staff responsibility for development of strategic concepts, estimates, plans, and broad force requirements. He defines and promulgates the current mission of the Army.

Strategy and Tactics Analysis Group. An activity under the control and supervision of the Deputy Chief of Staff for Military Operations. Its mission is to support Department of the Army operational planning and evaluation activities by war gaming and by application of allied techniques.

Deputy Chief of Staff for Logistics. Has General Staff responsibility for planning, coordinating, and supervising the advance production engineering and initial procurement that occur prior to completion of production acceptance testing and for management of all Army logistics activities.

Deputy Chief of Staff for Personnel. Has General Staff responsibility for policy, plans, and programs relating to the personnel of the Army.

Combat Developments Command. Directs Army combat development activities under the general supervision of Headquarters, Department of the Army. It develops concepts, doctrines, materiel objectives, requirements, and organization for the Army in the field and, in coordination with other commands, ensures that the requirements are compatible with Army support structures and systems developments.

Army Materiel Command. Performs assigned materiel functions of the Department of the Army comprising research and development; maintenance, production, and product engineering; testing and evaluation; procurement and production; integrated materiel inventory management; new-equipment training; technical intelligence; mutual security programs; and, as related to the continental U.S. wholesale supply and maintenance system, storage and distribution, transportation, maintenance, demilitarization, and disposal.

Army Air Defense Command. Commands all Army air defense forces allocated to the air defense of the United States.

SAFEGUARD System Command. Is responsible for accomplishing the approved development, acquisition, and installation of the SAFEGUARD System within the guidance and direction of the SAFEGUARD System manager.

AIR FORCE

Air Force Systems Command. Its mission is to advance aerospace technology, adapt it into operational aerospace systems, and acquire qualitatively superior aerospace systems and materiel needed to accomplish the Air Force mission. It is responsible for the research, development, production, and procurement actions required to place a complete aerospace system in operation.

Space and Missile Systems Organization. An organization of the Air Force Systems Command, it is the management agency for planning, development, testing, and acquisition of all Air Force space and ballistic missile systems.

Aeronautical Systems Division. An organization of the Air Force Systems Command, it manages the development and acquisition of aeronautical systems and related equipment.

Assistant Chief of Staff, Studies and Analysis. Provides the Air Force with capability for study and analysis of all types of military operations.

Aerospace Defense Command. Its mission is detection, identification, interception, and, if necessary, destruction of any aerospace threat to the North American continent.

Data Systems Design Center. Is responsible for providing support to the Air Force Staff managers in the design of computer systems.

NAVY

Assistant for War Gaming Matters, Chief of Naval Operations. Is responsible for coordinating all Navy-sponsored war gaming activities that contribute to review of planned naval warfare tasks.

Naval Air Systems Command. Is responsible for providing complete Navy and Marine Corps aircraft, including components, and air-launched weapons systems.

Naval Air Development Center. Is concerned with research and development of electronics, pilotless aircraft, armament, theoretical analysis and computations, experimental photography, airborne antisubmarine-warfare systems, aviation instruments, and aviation medicine.

Naval Weapons Center. Has broad responsibilities for research and development of naval weapons systems, particularly systems for air warfare.

Naval Underwater Systems Center, New London Laboratory. Plans and conducts programs of warfare and systems analyses, research, development, test, evaluation, and fleet support in underwater weapons systems and components, underwater surveillance systems, submarine communications systems, navigation, and related science and technology.

Naval Electronic Systems Command. Is responsible for the provision and life-cycle management of major electronic equipment and systems.

Naval Ordnance Laboratory, White Oak, Maryland. Concerned primarily with the research and development of air, surface, and underwater ordnance.

Fleet Computer Programming Center, Pacific. Is responsible for programming activity whose primary mission is to provide technical support for the Navy Tactical Data System in the Pacific area.